

# Analysis of Temperature and Relative Humidity Variation in Wheelchair Cushion Monitoring Tests

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## Introduction

- Clinicians need to prescribe wheelchair equipment that is tailored to the needs of the individual
- Relative humidity affects friction and skin's ability to withstand loads
- Increased tissue temperature increases metabolic demand and may affect tissue integrity
- Need to develop ISO standards for cushion testing

## Objectives

- Investigate relationship between temperature and relative humidity in controlled tests
- Monitor the same parameters in everyday use and assess the impact of user functionality
- Use results to create standardized lab test methods for characterizing cushion performance

## Methods

### MSR logger

- Temperature sensor, 0.1 C
- Relative humidity sensor, 2%
- Occupancy switch



### Controlled Test

- Same subject, same clothes, same chair
- Sensor located 2-3 cm forward of the ischial tuberosity
- Several cushions monitored for 45 min duration, some with 60 sec pressure reliefs every 15 minutes

### Empirical Test

- Attached logger and sensors inside cushion cover
- Logged data for approximately 1 week

### Data Analysis

- Bout of sitting: threshold set at 10 minutes
- Steady-state: initially defined as  $<1/2$  C/30 min

## Results

### Controlled Testing

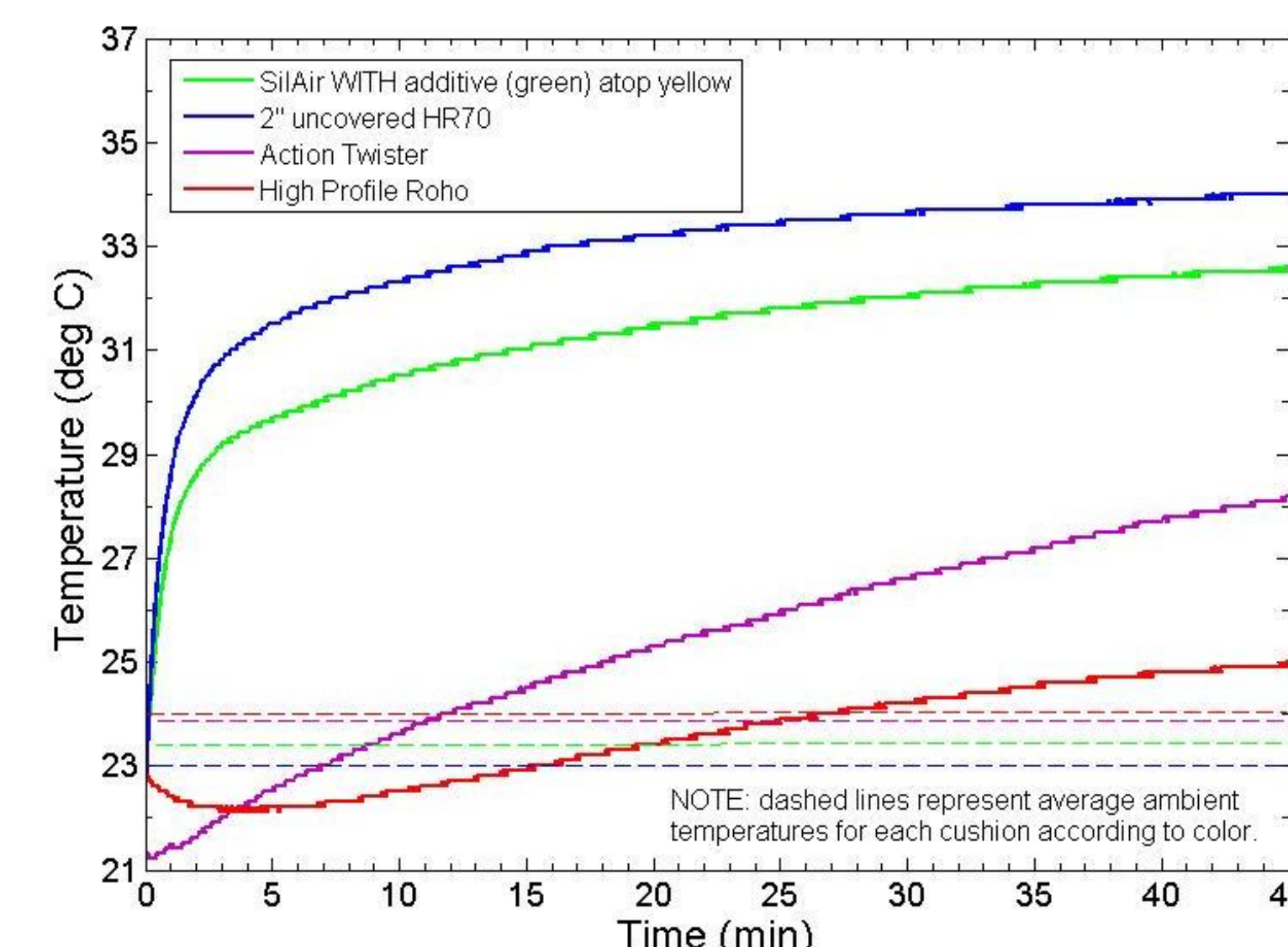
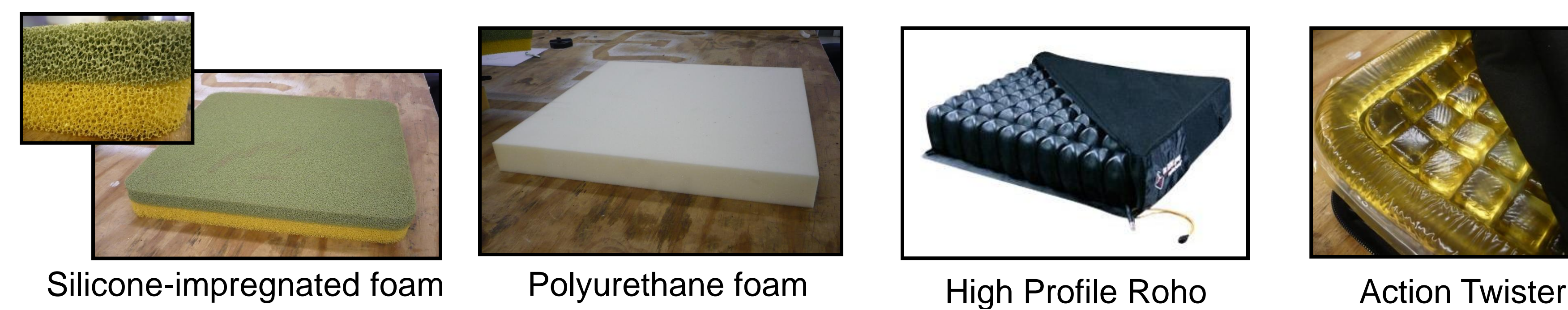


Figure 1. Cushion temperature variation for 45-minute bout

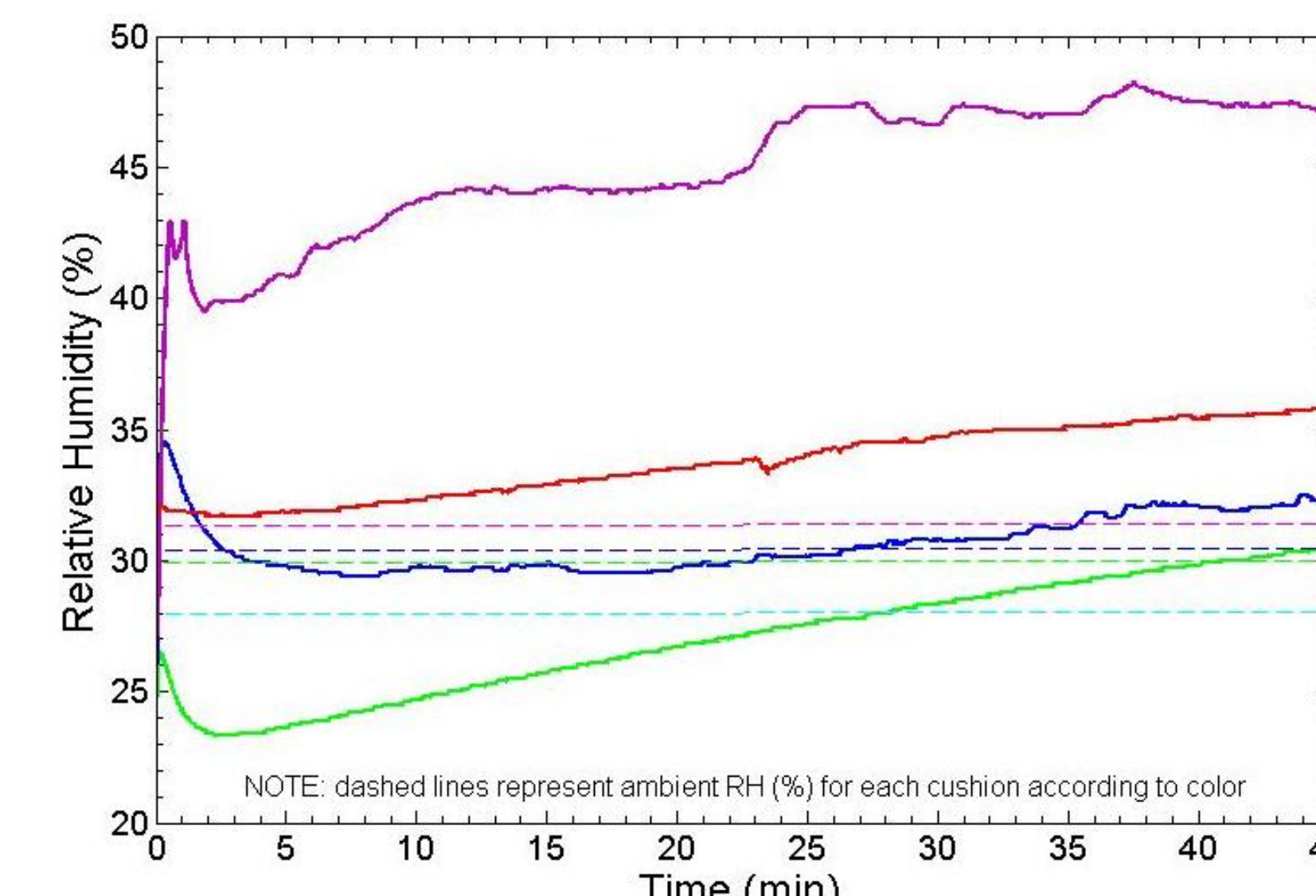


Figure 2. Relative humidity variation for 45-minute bout

### Empirical Testing

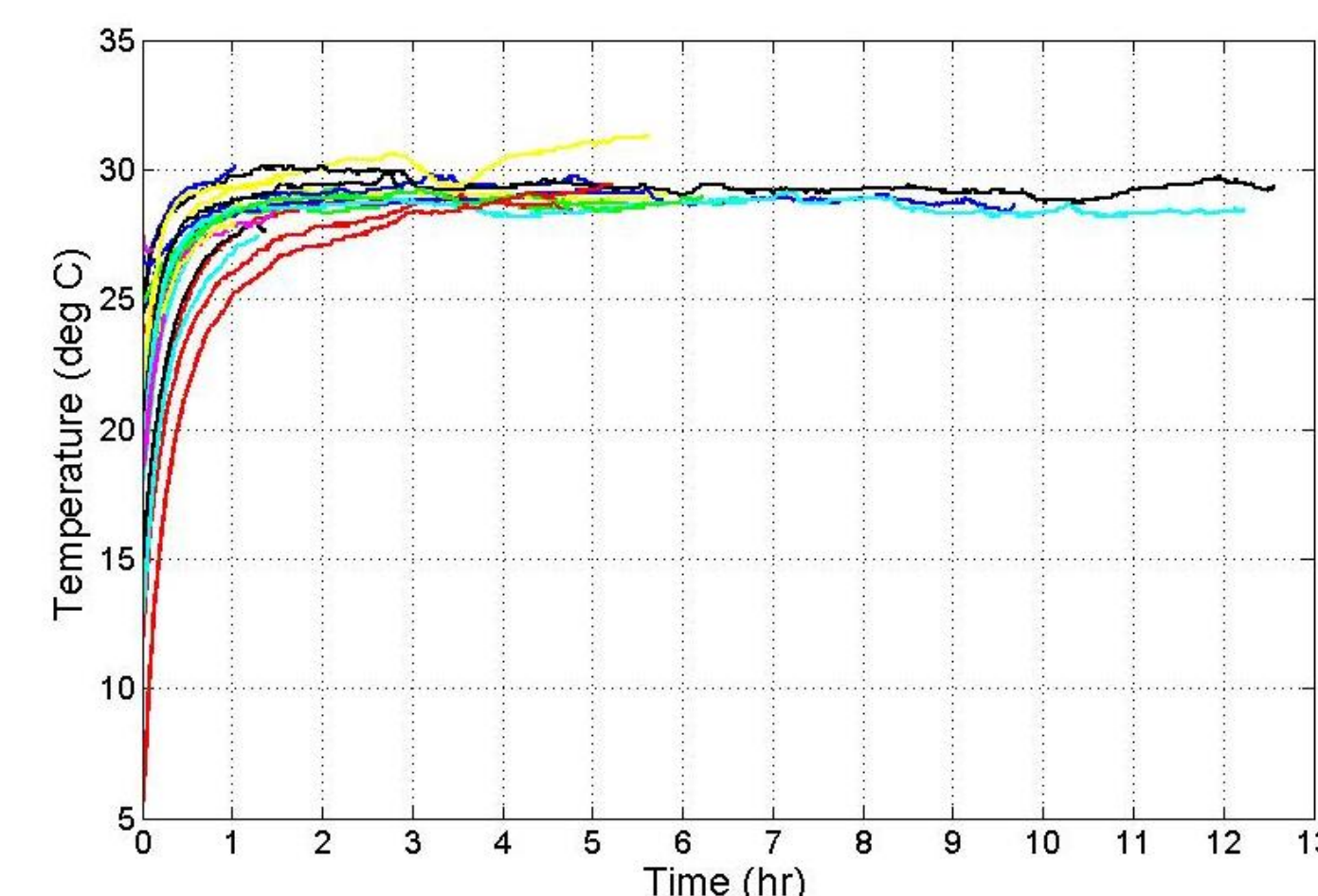


Figure 3. Temperature variation for all bouts (Roho Harmony)

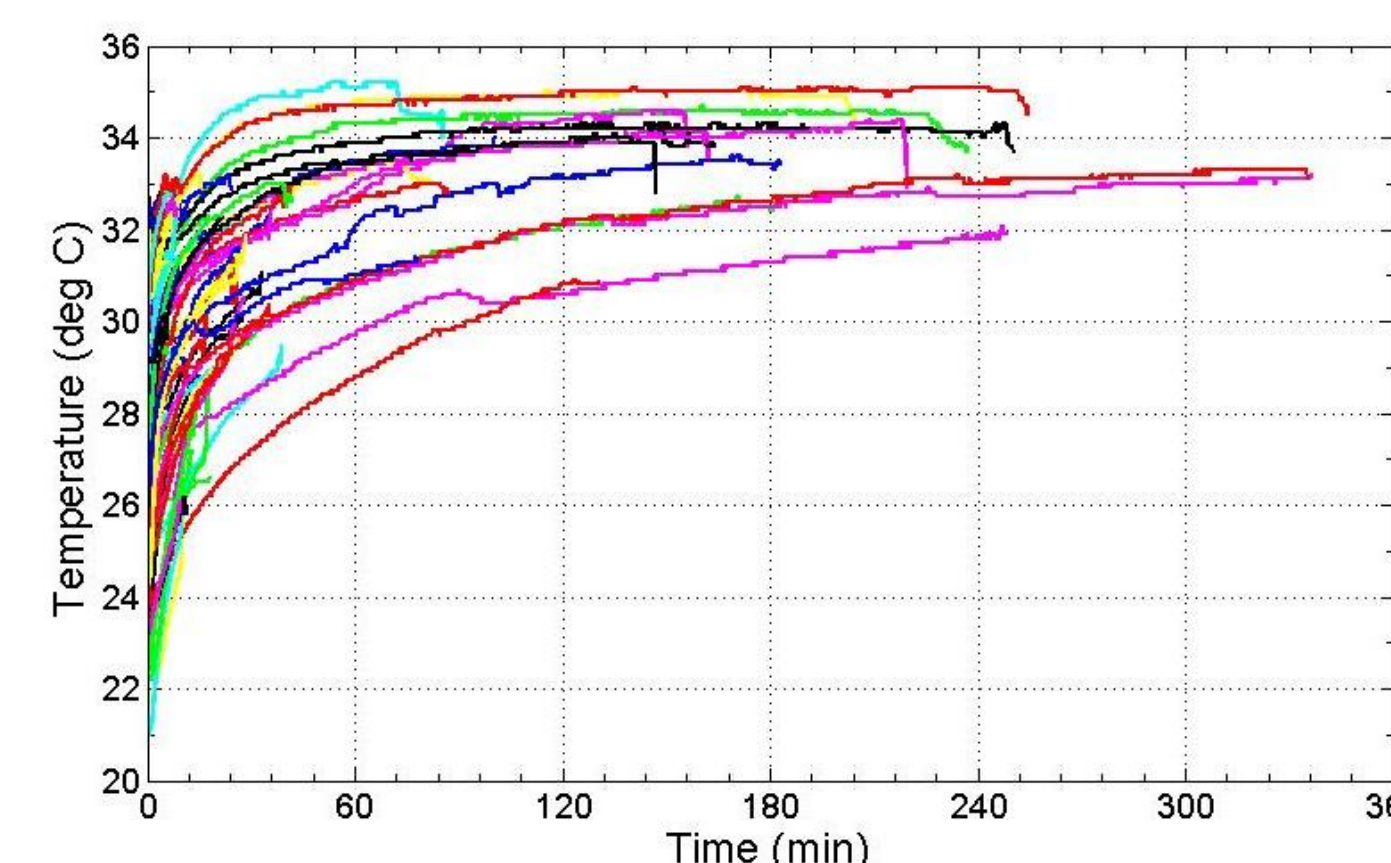


Figure 4. Temperature variation for all bouts (Jay 2)

- Roho Harmony (air cushion) has a tighter temperature range and more rapid rise to maximum temperature than the Jay 2 (viscous fluid cushion)
- Person using Roho Harmony had a bout  $>6$  hours 1+ times daily
- Person using Jay 2 got up more frequently

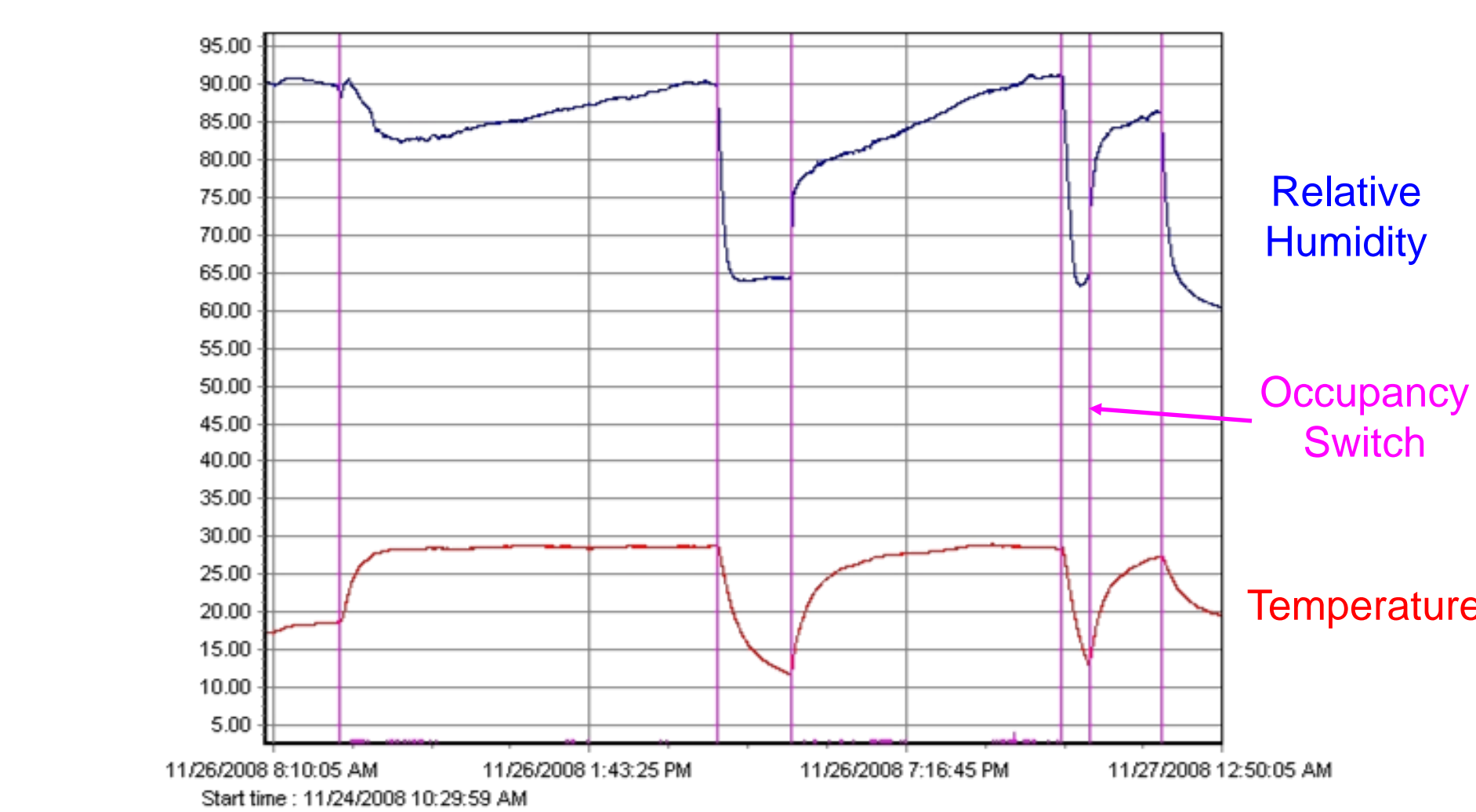


Figure 5. Temperature and relative humidity results over one day (long bouts)

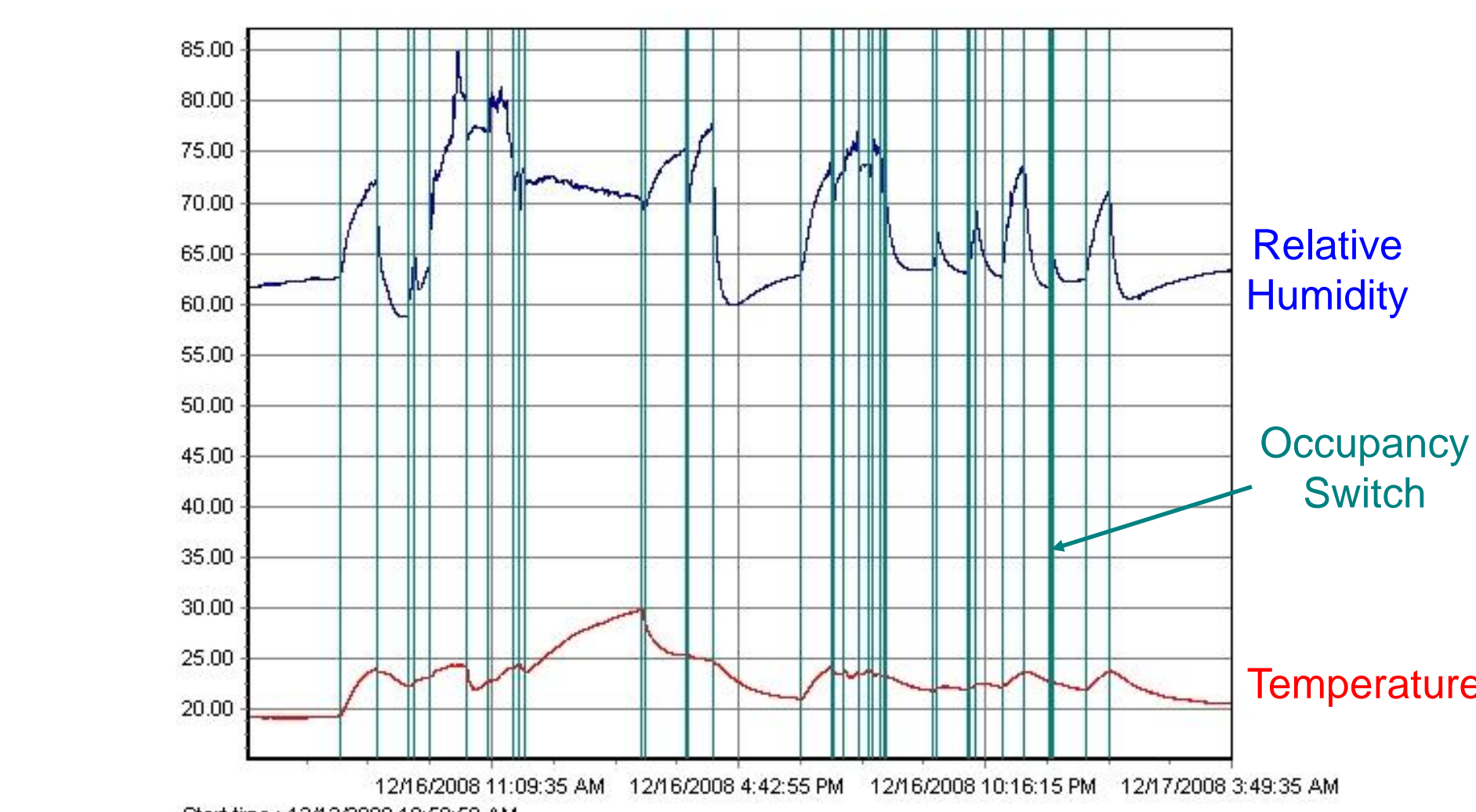


Figure 6. Temperature and relative humidity results over one day (short bouts)

- Two different subjects seated on different cushions
- Number of sitting bouts = 3 (Fig. 5) & 21 (Fig. 6)
- Bout length has an effect on temperature and relative humidity

## Conclusions

- Strong positive correlation between temperature and relative humidity
- Controlled tests did not reach steady-state, while most empirical bouts reached steady-state after approximately 90 minutes
- Cushions vary widely in microclimate management just like they vary widely in pressure management
- Movement is a good way to dissipate heat and alter shear and normal loading; can be facilitated through education, positive reinforcement
- Pressure reliefs are beneficial because they alleviate pressure and dissipate heat

## Future Work

- Increase sample size to increase reliability of results
- Use subject debriefing to better contextualize data
- Inform modifications to current standardized heat & humidity test method
- Compare results of human and lab tests to assess validity

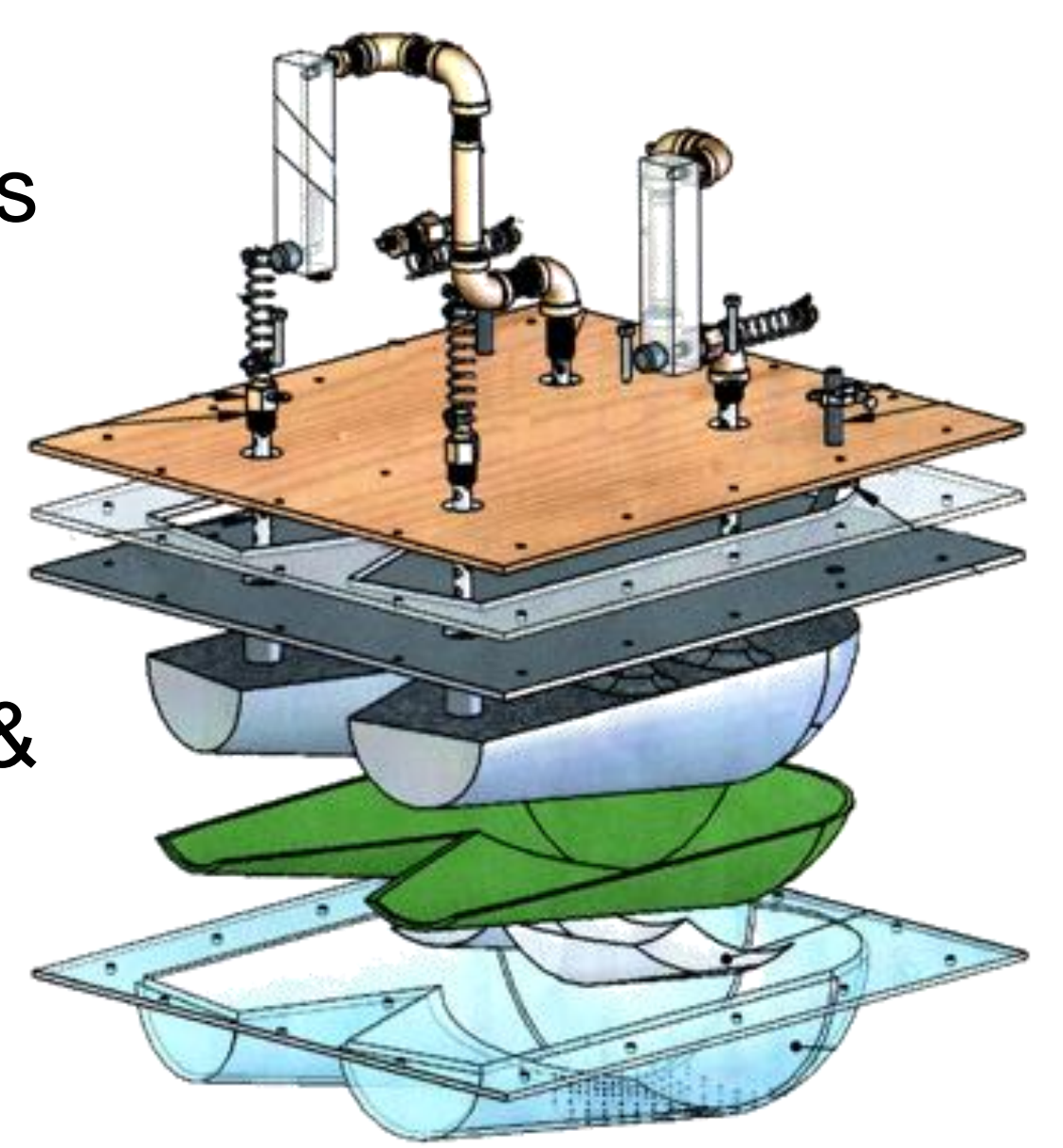


Figure 6. Exploded view of buttocks model used in standardized lab tests

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